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मानक

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IS 4308 (2003): Specification for Dry Chemical Powder for Fighting B and C Class Fires - [CED 22: Fire Fighting]



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“Knowledge is such a treasure which cannot be stolen”

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IS 4308 : 2003

Reaffirmed 2008

भारतीय मानक

बी और सी क्लास अग्नि शमन के लिए शुष्क
रासायनिक पाउडर -- विशिष्टि
(दूसरा पुनरीक्षण)

Indian Standard

DRY CHEMICAL POWDER FOR FIGHTING
BAND C CLASS FIRES — SPECIFICATION

(Second Revision)

ICS 13.220.10

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

April 2003

Price Group 7

AMENDMENT NO. 1 APRIL 2005
TO
IS 4308 : 2003 DRY CHEMICAL POWDER FOR
FIRE FIGHTING B AND C CLASS FIRES —
SPECIFICATION

(Second Revision)

(Foreword, para 3, lines 6 and 7) — Substitute 'bi-carbonates of alkali materials and potassium chloride' for 'sodium bicarbonate, potassium bicarbonate, potassium chloride etc.'

(Page 1, clause 4.3.1) — Add the following at the end of clause:

'Chemical content of the dry powder shall be determined as per Annex D.'

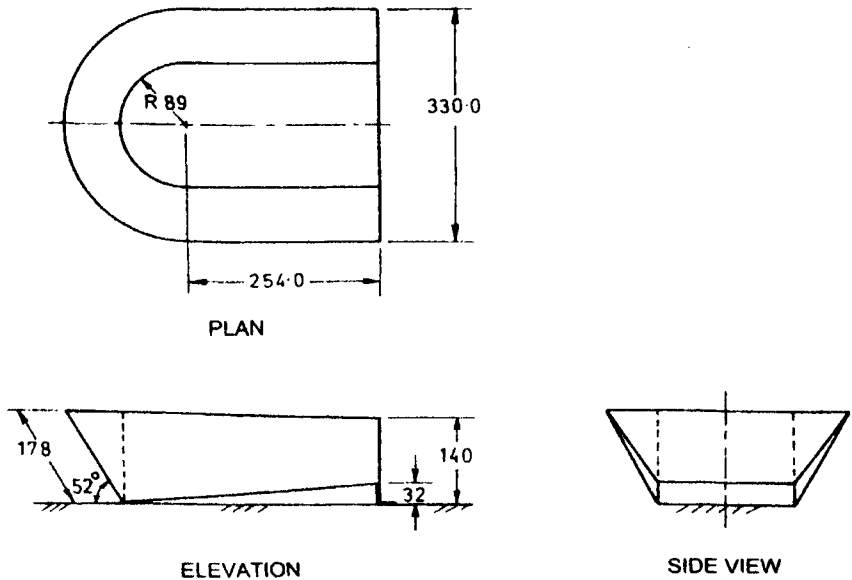
(Page 2, clause 4.6.2.1, line 9) — Delete ' $27 \pm 5^{\circ}\text{C}$ '.

[Page 8, clause 4.12.1.3(c)] — Substitute ' 2.8 kN/m^2 ' for ' 276 kN/m^2 '.

(Page 8, Fig. 6) — Substitute '364 mm' for '363.5 mm' and 'Φ 7.5 REGULATING VALVE' for 'Φ 75 REGULATING VALVE'.

(Page 9, Fig. 7) — Substitute the figure given on page 2 for the existing:

Amend No. 1 to IS 4308 : 2003



All dimensions in millimetres.

FIG. 7 FIRE PAN (STAINLESS STEEL SHEET 2.24 mm)

(Page 9, Fig. 8, Note) — Insert the following Note below the existing:

NOTE — The diameter of vertical cylindrical portion mounted onto the puffer chamber shall be as follows:

Inner dia	—	51.4 mm, and
Outer dia	—	57.6 mm.

Amend No. 1 to IS 4308 : 2003

(Page 13) — Insert the following Annex at the end of the committee composition:

ANNEX D
(Clause 4.3.1)

DETERMINATION OF CHEMICAL CONTENT

D-1 PROCEDURE — For the determination of chemical contents of dry powder, following procedure shall be followed.

D-1.1 Remove silicone by suitable solvent.

D-1.2 Weigh approximately 2 g of sample of dry powder and add 250 ml distilled water and mix it. If required, heat for solubility.

D-1.3 Add 2-3 drops of bromocresol green indicator. Colour of sample solution shall become blue.

D-1.4 Fill burette with 1 N sulphuric acid and start titration. In the end sample solution shall become colourless.

D-1.5 Note the reading of sulphuric acid used for titration.

D-2 CALCULATION

$$\text{Percentage of chemical} = \frac{V \times N \times \text{At. Wt}}{M}$$

where

V = volume in ml of sulphuric acid required for titration,

N = normality of sulphuric acid, and

M = mass in g of sample.

AMENDMENT NO. 2 MAY 2006
TO
IS 4308 : 2003 DRY CHEMICAL POWDER FOR FIRE
FIGHTING B AND C CLASS FIRES — SPECIFICATION
(Second Revision)

(*Amendment No. 1, see pages 1 and 3*) — Substitute the following for existing Annex D :

ANNEX D
(Clause 4.3.1)

DETERMINATION OF CHEMICAL CONTENT

D-1 COMPOSITION

D-1.1 Sodium or Potassium Bicarbonate Content

D-1.1.1 General — This method is intended to determine the bicarbonate content of sodium bicarbonate or potassium bicarbonate dry chemical fire extinguishing agents which may contain waterproofing and fluidizing agents and other materials required for satisfactory performance. This method assumes that all bicarbonate is present as the sodium salt or the potassium salt, as applicable.

D-1.1.2 Apparatus — The following apparatus shall be used:

- A* — Analytical balance, capable of weighing accurately to 1 mg;
- B* — Aluminium moisture dishes, 65 mm diameter × 44.5 mm high with closely fitting slip-over cover.
- C* — Glass desiccators — one containing 95 to 98 percent by mass reagent grade sulphuric acid as a drying agent or CaCl₂ /silica gel; another containing molecular sieves or 'Drierite' as a dry agent;
- D* — Oven, capable of operating in the range of 250°C; and
- E* — Sodium bicarbonate or potassium bicarbonate reagent.

D-1.1.3 Procedure — Heat a clean, capped aluminium moisture dish in an oven at 250°C for 30 min, transfer quickly to a desiccator containing 'Drierite' or molecular sieves. Allow contents to cool to room temperature, then weigh the capped dish quickly to 0.1 mg. This is the tare mass of the dish.

Amend No. 2 to IS 4308 : 2003

D-1.1.4 Transfer 2.5 to 3 g of sample into the aluminium moisture dish, weigh to the nearest 0.1 mg, and place separated cap and container in a desiccator over sulphuric acid. Dry to constant mass. This mass, less the tare mass of the dish, is the dry sample mass.

D-1.1.5 Heat the capped moisture dish with the dry sample in an oven at 25°C until loss in mass becomes constant (16 h or overnight has been found suitable). Every time the hot, capped moisture dish is removed from the cover to check progress of mass loss, it shall be quickly transferred to a desiccator containing fresh 'Drierite' or molecular sieves as the drying agent. After cooling to room temperature, the capped moisture dish must be weighed to an accuracy of ± 0.1 mg as quickly as possible.

D-1.1.6 Sampling, drying, heating and cooling conditions, and weighing technique shall be verified as necessary, using reagent grade sodium bicarbonate, or potassium bicarbonate, in place of the dry chemical fire extinguishing agent sample. A value over 99.0 percent NaHCO_3 for reagent sodium bicarbonate, or over 99.0 percent KHCO_3 for reagent potassium bicarbonate, shall constitute verification of the test procedure.

D-1.1.7 Calculation — Calculate the percentage of sodium bicarbonate, or potassium bicarbonate, in the dry sample as:

$$\text{Percentage NaHCO}_3 = \frac{a}{b} \times 270.9$$

or

$$\text{Percentage KHCO}_3 = \frac{a}{b} \times 322.8$$

where

a = loss of mass in g, after heating the sample at 25°C, and

b = the dry sample mass in g.

(CED 22)

**AMENDMENT NO. 3 AUGUST 2007
TO
IS 4308 : 2003 DRY CHEMICAL
POWDER FOR FIGHTING B AND C CLASS
FIRES — FIGHTING**

(Second Revision)

(Page 1, clause 4.3.1, fifth line):

- a) Substitute 'minimum' for 'more than' before 90 percent.
- b) Delete last sentence 'The allowed ----- constituents'.

(CED 22)

Reprography Unit, BIS, New Delhi, India

**AMENDMENT NO. 4 NOVEMBER 2008
TO
IS 4308 : 2003 DRY CHEMICAL POWDER
FOR FIGHTING B AND C CLASS
FIRES — SPECIFICATION**

(Second Revision)

*(Amendment No. 2, Annex D, page 1, clause D-1.1.3, line 4) — Substitute
'1 mg' for '0.1 mg'.*

*(Amendment No. 2, Annex D, page 2, clause D-1.1.4, line 2) — Substitute
'1 mg' for '0.1 mg'.*

*(Amendment No. 2, Annex D, page 2, clause D-1.1.5, line 1) — Substitute
'250°C' for '25°C'.*

*(Amendment No. 2, Annex D, page 2, clause D-1.1.7, line 7) — Substitute
'250°C' for '25°C'.*

(CED 22)

FOREWORD

This Indian Standard (Second Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Fire Fighting Sectional Committee had been approved by the Civil Engineering Division Council.

Fire fighting dry chemical powder meeting this standard is used in dry chemical powder fire extinguishers, fixed installations and mobile fire tenders for fighting Classes B and C fires. However, dry chemical powder for fighting A, B and C fires are covered under IS 14609 : 1999 'Specification for dry chemical powder for fighting A, B and C Class fires' and fire involving reactive metals that is, Class D fires as also radioactive metals are separately covered under IS 4861:1984 'Dry powder for fighting fires in burning metals (*first revision*)'.

The efficiency of dry chemical powder for extinguishments is governed by its physical properties and chemical composition. Particle size of the powder is an important characteristic which determines its fire knock down properties and keeping qualities when used in extinguishers. As very fine particle are carried away with flame draft, fine particles have better fire knock down properties but cannot be easily projected out, the coarse particles are also allowed to achieve better ballastic properties. Therefore fine and coarse powder particle must be balanced while manufacturing this powder. The dry chemical powder is generally composed of basically sodium bicarbonate, potassium bicarbonate, potassium chloride, etc, with additives to make it water repellent, free flowing and conforming to various requirements of this standard. While selecting the various raw materials for the manufacture of this dry chemical powder, It shall be ensured that these are non-toxic, non-corrosive, non-abrasive and electrically non-conductive.

In the following situations, the application of dry powder covered in this standard should not be considered satisfactory:

- a) Fires involving chemicals containing their own oxygen supply such as cellulose nitrate, etc;
- b) Fires involving radio-active metals such as radium uranium, polonium, etc;
- c) Area where residual deposits of the powder may adversely affect electronic equipments or delicate electrical relays; and
- d) Fire involving combustible metals such as alkali metals, magnesium titanium, zirconium, etc.

This standard is formulated to provide guidance regarding selection of materials and requirements in regard to the quality of dry powder used for Class B and C fires. This revision incorporates procedures for particle size distribution determination, hygroscopicity, moisture content and guidance notes for use of this powder. The requirements for hygroscopicity and caking, free flow characteristics, foam compatibility and fire knock down properties have been modified apart from general updation. The various tests for Class B and C fires incorporated in this standard are based on the studies conducted at the Defence Institute of Fire Research, New Delhi and also taking into consideration the International Standards such as ISO, EN, UL, etc.

The composition of the Committee responsible for the formulation of this standard is given at Annex C.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

DRY CHEMICAL POWDER FOR FIGHTING B AND C CLASS FIRES — SPECIFICATION

(Second Revision)

1 SCOPE

This standard lays down the requirements of dry powder for use as extinguishing medium for fighting Class B and C fires.

2 REFERENCES

The standards given in Annex A contain provisions which through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards given at Annex A.

3 TYPES

The dry chemical powder shall be ordinary or compatible with all types of foams covered under IS 4989 (Parts 1, 2 and 3). The test requirements for foam compatibility are given in 4.11.

4 QUALITATIVE REQUIREMENTS

4.1 The sample of dry powder for testing shall be drawn in such a manner that it represents the entire strata of powder from any container and shall be tested for properties mentioned in the following clauses.

4.2 Apparent Density

The apparent density of the dry chemical powder when determined by the method given in 4.2.1 shall be 1 ± 0.15 .

4.2.1 A sample of 100 ± 1 g of the dry powder shall be placed in a clean, dry 250 ml, stoppered glass graduated measuring cylinder having an approximate height of 320 mm and approximate internal diameter of 40 mm. Secure the stopper in cylinder. Rotate the cylinder for ten complete revolutions, slowly at a rate of approximately 1 revolution every 2s. Immediately after the ten revolutions have been completed, set the cylinder upright on a level surface and allow the powder to settle for 180 s. Read off the volume occupied by the powder and calculate the apparent density from the following equation:

$$\text{Apparent density} = 100/\text{volume of powder in ml}$$

4.3 Chemical Content

4.3.1 The declared chemical content of the dry chemical powder need not include constituent making up less than 10 percent by mass of the extinguishing powder. However, the chemical content declared shall cover more than 90 percent of basic material of total composition of the extinguishing powder. The allowed tolerance shall not exceed ± 3 percent of the declared value for constituents.

4.4 Particle Size Distribution

4.4.1 When tested as per IS 1607 the particle size distribution shall be as given in Table 1.

Table 1 Base Characteristics
(Clause 4.4.1)

Sl No.	Particle Size (Percent Retained on)	Minimum	Maximum
(1)	(2)	(3)	(4)
i) 0.425 mm/40 mesh sieve		0	0
ii) 0.150 mm/100 mesh sieve		0	2
iii) 0.075 mm/200 mesh sieve		0	10
iv) 0.045 mm/325 mesh sieve		10	35
v) Bottom pan		53	90

NOTE: — The duration of sieving shall be 30 min for hand sieving and 10 min for machine sieving.

4.5 Hygroscopicity

4.5.1 A sample of dry chemical powder shall be deemed to have met the requirement of hygroscopicity if the percentage gain in mass due to moisture absorption does not exceed 1.5 percent.

4.5.2 Procedure

Weight accurately 10 g of dry chemical powder in a 250 ml beaker. Keep the beaker in a desiccator at 80 percent relative humidity obtained using standard glycerin water mixture. Take the weight of the beaker after 48 h. Increase in weight shall be noted and percentage hygroscopicity shall be calculated as follows:

$$\text{Percent hygroscopicity} = \frac{\text{Increase in weight of sample}}{\text{Original weight of sample}}$$

4.6 Caking Test

4.6.1 Procedure

Take 100 g of powder in a 250 ml beaker and store the beaker in an atmosphere having relative humidity 92 percent at $27 \pm 2^\circ\text{C}$ for a period of 6 h. Then transfer the same to a desiccator containing sulphuric acid (98 percent w/w H_2SO_4) for a period of 24 h. Observe the formation of any caking or lump in the powder. In case there is any caking or lump formation, allow it to drop from a height of 200 mm on a smooth hard surface. The lump shall be friable to pass the requirements given in 4.4.1.

4.6.2 Resistance to Caking, Lumping and Hardness of the Caking

A sample of dry chemical powder shall be deemed to have passed the test if the penetration of the needle is found more than 15 mm.

The resistance of the dry chemical powder to caking and lumping shall be determined by preparing the samples as described in 4.6.2.1 and using a suitable penetrometer as specified in 4.6.2.2 and operating it as per instructions contained in 4.6.2.3. Determine the penetration distance three times at three non-collinear points across the surface of the dry powder fire extinguishing agent on each of the two samples. Determine the arithmetic mean and report the same as the penetration distance.

4.6.2.1 Sample preparation

Place 100 g sample of powder in a nickel crucible shaped cup of suitable capacity. Similarly prepare another sample. Mount both the cups on a suitable sieve shaker in holders and subject the powder to vibrations until there is no further compaction observed, but in any event for not less than 5 min.

Expose the sample to humid atmosphere by keeping them in a moving air stream humidifier described in Fig. 1 at $27 \pm 5^\circ\text{C}$ and minimum 78 percent relative humidity for 24 h, followed by drying for 24 h by keeping in a electric oven maintained at $48 \pm 3^\circ\text{C}$.

NOTE — Stagnant air conditions found in the usual saturated solution desiccator compartments may not give consistent results and precautions shall be taken to ensure air circulation if a desiccator is used as the humidifier. A 250 mm internal diameter desiccator with a saturated ammonium chloride solution in the lower compartment may be used in this determination. During the test, circulate air at 5 l/min. Pre-saturate the air by bubbling through distilled water and then through a saturated ammonium chloride solution and introduce into the desiccator through a centre tube having an internal diameter of 6 mm, terminating 20 mm above the centre in the desiccator porcelain round plate. Check the relative humidity of the exit air stream from time to time using some convenient means.

4.6.2.2 Equipment

The penetration apparatus (see Fig. 2) consists of a penetrometer (see Fig. 3) with a needle in a holder (spindle) able to move vertically without measurable friction and capable of indicating the depth of penetration to the nearest 0.1 mm. The mass of the spindle shall be 47.5 ± 0.05 g and the total mass of needle and spindle assembly 50.0 ± 0.05 g.

The needle shall be made of fully hardened and tempered stainless steel. It shall be approximately 50 mm in length and 1.02 mm in diameter, symmetrically tapered at one end by grinding to a cone having an angle between 8.7° and 9.7° for the entire cone length. The cone shall be coaxial with the straight body of the needle. The total axial variation of the intersection between the conical and straight surfaces shall not exceed 0.2 mm. The truncated tip of the cone shall be within the diameter limits of 0.14 and 0.16 mm and square to the needle axis within 2° . The entire edge of the truncated surface at the tip shall be sharp and

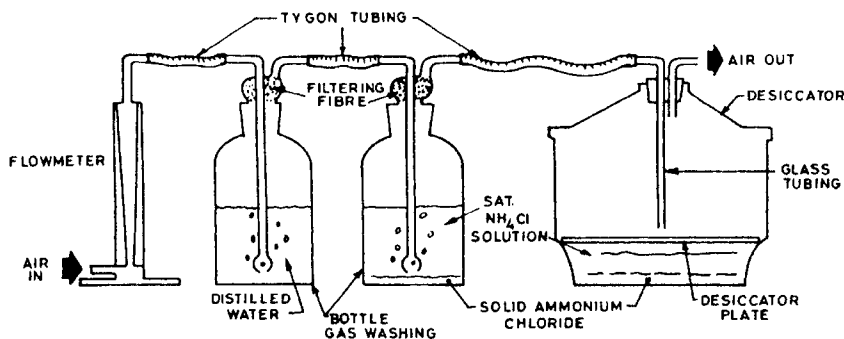


FIG. 1 MOVING AIR STREAM HUMIDIFYING APPARATUS

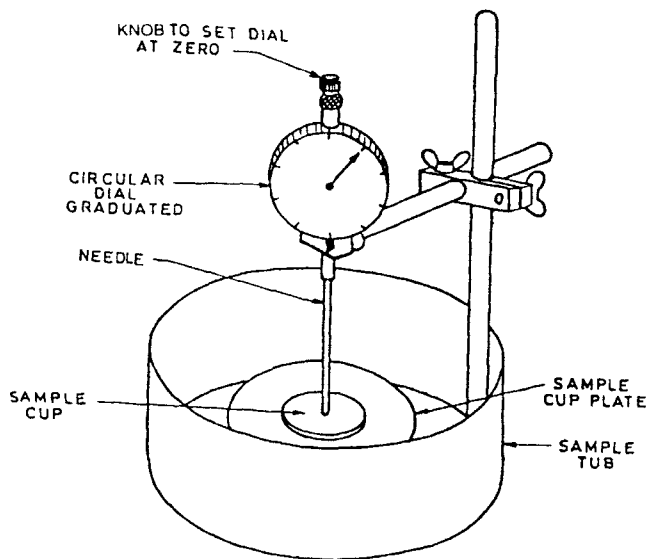


FIG. 2 TEST ARRANGEMENT FOR HYGROSCOPICITY AND CAKING TEST

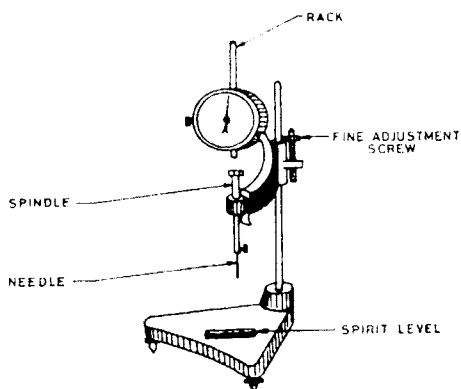


FIG. 3 PENETROMETER

free of burrs. The surface roughness height of the tapered cone surface shall be 0.2 to 0.3 microns arithmetic average. The needle shall be mounted in a stainless steel made ferrule and the exposed length being between 40 to 45 mm. The ferrule shall be 3.2 ± 0.05 mm in a diameter and 38 ± 1 mm in length. The needle shall be rigidly mounted in the ferrule. The mass of the ferrule needle assembly shall be 2.50 ± 0.05 g.

4.6.2.2.1 Penetrometer

It is designed to measure in mm and tenths of a mm the penetration of the needle, permanently fixed in a brass ferrule which in turn is held at the lower end of a vertically movable spindle which is made to fall freely without friction under the gravitational force into dry chemical powder held in a cup that has been compacted and exposed to humid atmosphere followed by drying as specified.

Before letting the spindle fall down, it is held in static position in a guide against a spring loaded button. In order to let the assembly of needle, ferrule and spindle fall down the spring loaded button has to be pressed and kept pressed for 5 s. The penetration, that is, the

distance the spindle, needle and ferrule assembly has travelled down is manually measured by using a movable rack and fixed pinion arrangement having a pointer fixed on the axle of the pinion. This pointer is fixed at the centre of a circular graduated dial.

When the upper end of the vertical rack is manually pressed, the pointer rotates over a circular dial having equal divisions graduated from 0 to 400.

4.6.2.3 Operating instructions for penetrometer

- a) Ensure that the needle made of stainless steel is rigidly and permanently fixed in a brass rod called ferrule.
- b) Loosen the screw provided on the lower end of the spindle. Insert the brass ferrule of the penetration needle into the needle holder called spindle and tighten the screw so that needle may not come out during measurements.
- c) Level the penetrometer by suitably rotating the three levelling screws provided on the base and seeing the air bubble of the spirit level provided on the base so that air bubble should rest in the centre of the spirit level.
- d) By keeping the button pressed manually raise the spindle, that is, the needle holder with needle and ferrule assembly till the upper flat end of the spindle touches the lower end of the rack made of square rod of brass.
- e) Loosen the small knob provided on the left of the graduated circular dial and manually sliding it up or down and tightening, that is, by manipulating the screw set the dial such that pointer reads 400 (or zero).
- f) Keep the cup holding the caked sample powder on the base of the penetrometer in the centre.
- g) Holding the arc shaped arm loosen the L-shaped bolt. Now lower the arc shaped arm (spindle and needle assembly) till the truncated tip of the needle remains say 10 mm above the surface of the dry powder. Now screw up the L-shaped bolt.
- h) Loosen the screw provided on the left side of arm and rotate the fine movement adjustment screw provided on the right side of the arc shaped arm.

By moving the fine movement screw system attached to the arm in anti-clockwise direction as seen from above, the needle gets lowered and *vice-versa*, that is, by moving the fine movement screw the clockwise direction the level of needle goes up. Adjust the fine movement screw till the truncated tip of the

needle just touches the upper surface of the caked powder sample held in the cup.

- j) Now press the spring loaded button for 5 s to release the assembly of needle, ferrule and spindle and let this assembly of needle, ferrule and spindle fall freely under the earth's gravitational force. It is essential that this fall of needle should take place without friction.
- k) After releasing the button when the downward movement of needle and spindle assembly stops. Note the distance the needle has penetrated into the dry powder sample as read on the dial by manually pressing with thumb at the upper end of the square ended rack till the lower end of the rack touches the upper flat end of the spindle.

4.7 Water Repellency Test

4.7.1 Procedure

Dry powder weighing 50 g shall be placed in a tared that is clean dry and weighed beaker and gradually filled with 50 ml of distilled water. After 2 min, the dry powder and the water from the beaker shall be gently poured out and the beaker with wet powder, if any sticking to the beaker, dried in an oven at 60°C for 2 h and then cooled in a desiccators containing anhydrous calcium chloride for 1 h. The beaker shall then be weighed and the weight of dry residue calculated. The increase in the weight of the beaker due to powder residue sticking to the beaker shall not exceed 0.75 g that is 1.5 percent.

4.8 Moisture Content

4.8.1 The moisture content shall not exceed 0.25 percent (*m/m*).

4.8.2 In an atmosphere of 50 ± 5 percent relative humidity and a temperature of $27 \pm 5^\circ\text{C}$, place a sample of approximately 50 g for 6 h into a tared aluminium dish having 65 mm diameter and 15 mm depth and weigh accurately. Place the dish holding powder sample in a desiccator using 95 to 98 percent by mass reagent grade sulphuric acid as a drying agent. Maintain the closed desiccator contents at a temperature of $21 \pm 5^\circ\text{C}$ for 24 h. At the end of this period, remove the test sample and weigh accurately. Calculate the moisture content of the sample from the following equation:

$$M = \frac{W_1 - W_2}{W_1 - W} \times 100$$

where

M = moisture content, in percent,

W = mass of empty, clean and dry aluminium dish,

W_1 = mass of aluminium dish holding powder before drying, and

W_2 = mass of dish holding powder after drying the powder.

4.9 Heat Resistance Test

4.9.1 The dry powder sample weighing 150 ± 2 g shall be placed in a tinned steel cup having 75 mm diameter and 50 mm depth provided with a closely fitting flanged cover/lid. The lidded cup holding the powder shall then be placed in a thermostatically controlled oven maintained at a temperature of $60 \pm 2^\circ\text{C}$ for a week. The sample shall then be cooled and examined for a caking or lumps formation. The lumps or cakes, when dropped from a height of 100 mm on a smooth glass surface or some other hard surface, shall be friable to pass the requirement of particle size distribution laid down in 4.4.

NOTE – Meeting of this requirement ensures that the dry powder is thermally stable and shall not decompose in normal ambient extreme temperature. Also it ensure that non of its constituents including additives shall melt at an elevated temperature of 60°C if it is not so the powder shall be rendered non-effective extinguishing agent when used in extinguisher(s) kept in locations having higher temperature such as boiler rooms, and near pipes carrying hot chemicals, steam, etc, in industries.

4.10 Free Flowing Characteristics (Efficient Fluidity)

4.10.1 A dry chemical powder having howsoever good fire inhibitory property when used in extinguishers may be rendered ineffective if it does not flow in pipes satisfactorily.

Dry chemical powder are generally filled in extinguisher bodies whether portable or wheeled units or in fixed installations or in special dry chemical powder tenders. Moisture free compressed gases like nitrogen, carbon dioxide or air are used to drive out the powder. In doing so the powder is required to flow through metal pipes, bends, rubber flexible hoses, etc. If the powder has less mobility it can not be driven out satisfactorily hence can not be projected on fire.

In the design of good extinguishers an effort is made to loosen or aerate the powder before its finding way into the discharge pipes and fittings, etc so that a non-pulsating jet of powder is obtained.

4.10.2 Equipment

The device consists of two numbers of Erlenmeyer glass conical flasks each of 1 000 ml capacity. One flask is inverted over the other such that they meet mouth to mouth. A clean, dry flask holding a known mass of powder 500 g under test is kept horizontally. A rubber collar tube is put on its neck. A disc made out of 1 mm thick stainless steel sheet and having a concentric aperture of 26 mm diameter is fixed horizontally into the neck. A similar clean, dry

Erlenmeyer flask is inverted over the horizontal one and the free end of the rubber made collar tube is slipped over so that it covers the neck. The purpose of rubber tube made collar is to hold the two flasks mouth to mouth meeting. A suitable apparatus is shown in Fig. 4.

4.10.3 Procedure

This assembly is held vertically by their necks in a suitable stand. The assembly of the two flasks is then turned rotated by 180° and kept held in this position, till all the powder mover/flows down to the lower flask. In this process some aeration of the powder sample takes place. As soon as the entire quantity of powder falls into the lower flask, the assembly is immediately again turned 180° and held in this position. In this way the process of aeration is continued and repeated so that in all aeration is done only ten times. Note that this aeration is to be done in quick succession without stopping in between consecutive aeration.

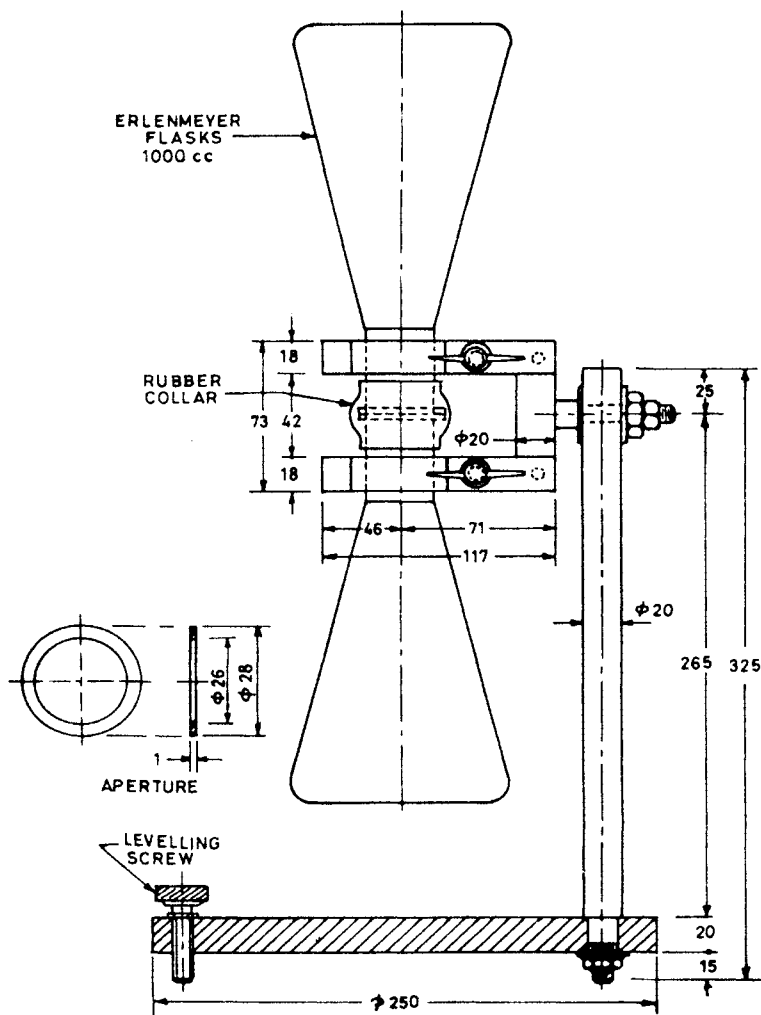
Immediately after the tenth run is over the measurement of fluidity is commenced by recording the period in s required for the powder to flow through completely. In quick succession total ten measurements are carried out. The arithmetic mean time 't' of these timings is calculated. Then the rate of flow that is, fluidity of powder is calculated by dividing the quantity 500 g by mean time 't' second. The sample of the powder is deemed to have passed the requirement of fluidity if the rate of flow is not below 50 g/s.

4.11 Foam Compatibility

4.11.1 Equipment

The equipment shall consist of the following:

- A foam making branch pipe having water discharge capacity of 7.5 l/min at 7 kgf/cm² pressure connected to a pressure vessel through a flexible rubber hose on one side. The pressure vessel is to be pressurized with the help of an air compressor as shown in Fig. 3 of IS 4989 (Part 1).
- A fire tray measuring internally 60 cm × 25 cm × 20 cm deep made out of 3 mm thick mild steel sheet, with all welded, leak proof construction. The tray shall be kept on a stand and shall have a sparged pipe of stainless steel fitted on one side as shown in Fig. 5. The sparged pipe shall have a spigot made on the free end so that the LPG rubber tubing may be easily and securely connected to it.
- A domestic LPG gas cylinder fitted with regulator and rubber tube.
- A suitable torch to set petrol, LPG on fire.



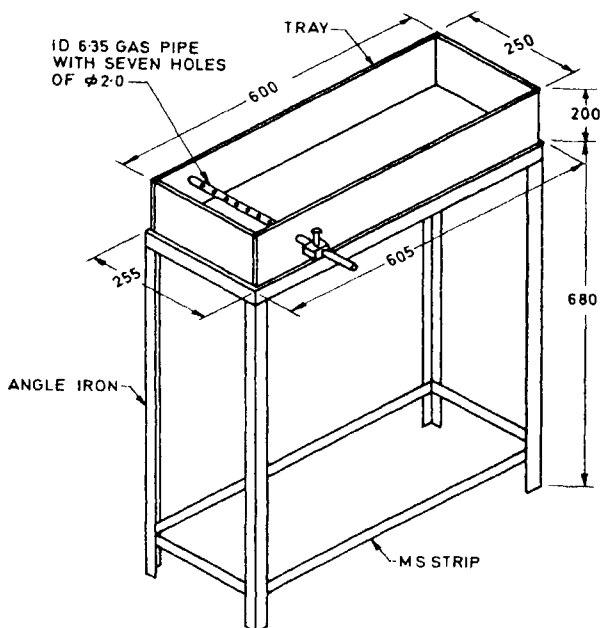
All dimensions in millimetres.

FIG. 4 ARRANGEMENT OF EQUIPMENT FOR FREE FLOWING

4.11.2 Procedure

The following procedure shall be followed:

- Keep the fire tray measuring internally 60 cm length, 25 cm breadth and 20 cm height on a 68 cm high stand as shown in Fig. 5. The tray should be clean and ensure that none of the holes made in the sparge pipe are clogged.
- Pour 8 l of clean potable water into the tray so that the sparge pipe gets submerged.
- Keep foam generating arrangement ready. The pressure vessel is to be charged with a premixed solution of protein foam concentrate conforming to IS 4989 (Part 1) at 4 percent concentration (v/v) in clean potable water.
- Pour 3 l of *n*-haptane into the fire tray holding water layer.
- Ignite the fuel and let it burn freely for 10 s.
- Using a suitable goose neck fitted on the foam making branch pipe apply foam into the tray



All dimensions in millimetres.

FIG. 5 TRAY WITH STAND

- on fire for 10 s.
- g) Start a stop watch.
 - h) Meanwhile, immediately connect the domestic LPG gas line to the free end of the sparge pipe.
 - j) Thirty second after the completion of foam application, open the gas line and ignite the LPG bubbling out of the foam blanket from the sparge pipe. Immediately start noting down the time period required for complete area of tray to be involved into flames. Let this time be called T_1 second.
- NOTE: - Throughout the test LPG gas supply is to be maintained at full throttle.
- k) Extinguish the fire. Let the tray cool down.
 - m) Report the procedure as given above from (a) to (e).
 - n) Put 60 g of the dry chemical powder sample under test above the platform of the butterfly valve of the puffer chamber. By operating the puffer chamber at 276 kN/m² (40 psi), apply the powder on the burning tray. This makes the fuel surface hot and powder particles remain on exposed surface of fuel. The fire may or may not go out.

- p) Immediately apply foam for 10 s as done previously in (c) to (f).
- q) Now repeat (g) to (j).
- r) Record the time taken for involvement of complete area of tray into flames. Let this time be T_2 second. A dry powder sample shall be deemed compatible with the foam sample with which it is tested if T_2 is not less than one half of T_1 .

NOTE: - For application of foam into tray the operator should wear fire protective hand gloves and face shield and use a suitable goose neck on the foam making nozzle

4.12 Fire Knocking Down Properties

4.12.1 Procedure for Class B Fire

4.12.1.1 Equipment

The equipment shall consist of the following:

- a) An air compressor,
- b) An air pressure regulator and moisture trap (to eliminate moisture from compressed air) suitably mounted on a stand,
- c) Weighing scales, weights and a plastic or stainless steel spoon.

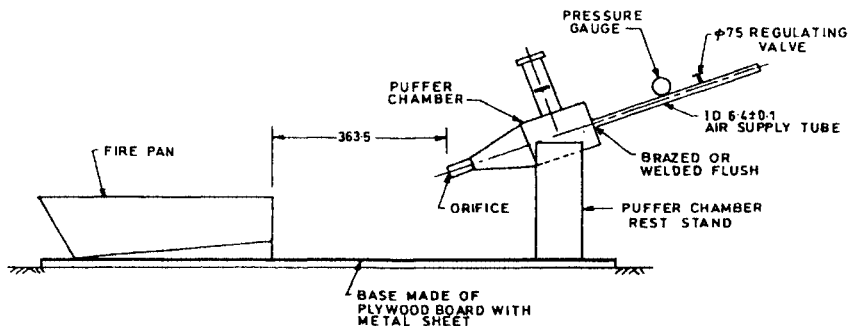
- d) A stop watch,
- e) A small torch and match box,
- f) Stainless steel fire pan, as shown in Fig. 7,
- g) Stainless steel fire pan cover, made of asbestos sheet,
- h) A puffer chamber made out of stainless steel sheet mounted on a stand, as shown in Fig. 8, and
- j) A graduated glass measuring cylinder of 1 l capacity.

4.12.1.2 Fuel

600 ml of normal heptane.

4.12.1.3 Procedure

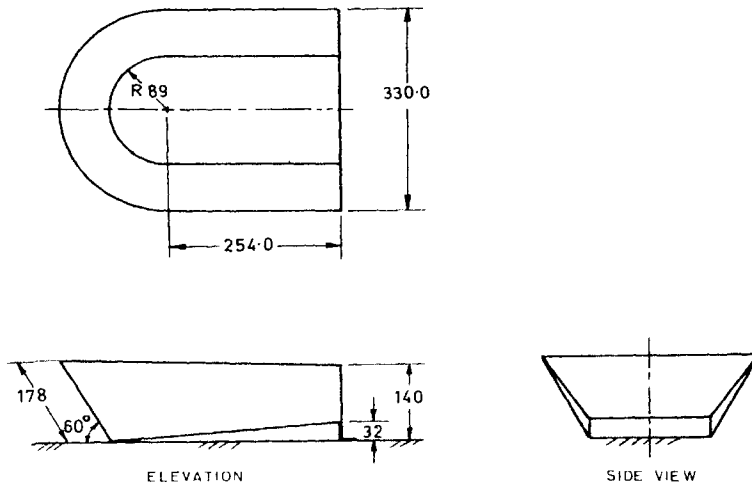
- a) Arrange the equipment as shown in the on a 1 m high table provided with a non-combustible top, kept in a draught free room or enclosure fitted with exhaust fan(s) to vent out smoke when the test is over.
- b) Connect the puffer chamber to compressed air reservoir using a high pressure rubber hose line through an air pressure reducer-cum-regulator and a moisture trap.
- c) With the puffer chamber valve shut, regulate the pressure of compressed air till the pressure of the moisture free compressed air is set at 276 kN/m².
- d) Fill the outer area of the semielliptical shaped fire pan up to 2 mm below the edges with clean potable water.
- e) Next, pour 5 l of water into the inner area of the fire pan.
- f) Weight 30 ± 1 g of the sample powder. Weigh five numbers of such samples.
- g) Remove the cap kept on the cylindrical stainless steel pipe embodying the butterfly valve. Pour this mass of powder into the pipe provided so as to place the powder on to the platform of the spring loaded butterfly valve in closed position of the puffer chamber. Replace the cap.
- h) Gently pour 600 ml of *n*-heptane as fuel over water container in the inner area of the fire pan taking care that no fuel is splashed into the outer area. The level of water is to be adjusted in the inner area such that top layer of the fuel is about 2 mm below the front edge. Due care is to be exercised while pouring fuel to avoid splashing of the fuel into the outer area to avoid conditions resulting in inconsistent fires or fires in the outer area and consequently inconsistent results.
- j) Ignite the fuel and simultaneously start the stop watch and let the fuel burn freely for 10s. As soon as 10s are over, simultaneously fully turn the butterfly valve in anti-clockwise direction so as to open the valve. Also operate the pet cock/stop cock provided on the compressed air line so as to let compressed air line open and sample powder falling on the puffer chamber inner plate get introduced instantly into the air stream which is delivered on the fire in the form of a dry powder cloud or dry powder puff over the flames which sweeps out the burning flames to cause extinction of fire. Conduct the test five times out of which the sample powder must extinguish the fire four times. If extinction is achieved in the first four tests the fifth one need not be carried out.



NOTE : Typical arrangement has been given and single or double pan may be used as jacket optional.

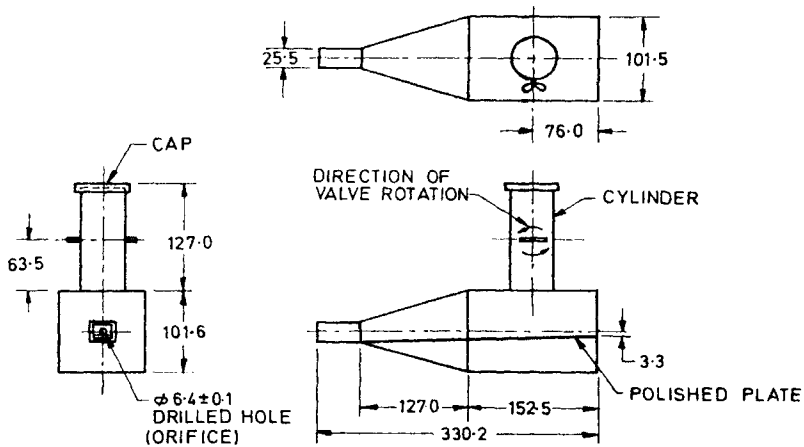
All dimensions in millimetres.

FIG. 6 GENERAL ARRANGEMENT OF EQUIPMENT FOR FIRE TEST



All dimensions in millimetres.

FIG. 7 FIRE PAN (STAINLESS STEEL SHEET 2.24 mm)



NOTE: Permissible deviation ± 0.5 .

All dimensions in millimetres.

FIG. 8 PUFFER CHAMBER (STAINLESS STEEL SHEET 1.6 mm)

NOTES

1 This test must be done in a room or enclosure where the wind does not disturb the fire.

2 A suitable Halon 1211 extinguisher or CO₂ extinguisher or dry chemical powder extinguisher or AFFF stored pressure mechanical foam extinguisher must be kept in attendance to meet any fire out-break exigency arising due to non-extinction of fire or other reasons.

3 To obtain repeatable results the fire pan must be allowed to cool down before repeating the test.

4.12.1.4 Precautions

Following precautions shall be taken during the test:

- a) The distance between the lower edge of the outlet of puffer chamber and the nearest edge of the fire pan is of critical importance and should therefore be maintained as shown in Fig. 8.
- b) The angle at which puffer chamber rests on the stand is also of critical importance.

4.12.2 Procedure for Class C Fire

4.12.2.1 Any powder meeting the requirements of Class B fire tests as described in 4.12.1, in addition be deemed to possess the potential for achieving an adequate performance on Class C fires that is, fires involving gasses.

4.13 Colour

The powder shall be of white colour.

5 GUIDANCE NOTES

- a) All extinguishing powder must be safe for use on live electrical equipment, and must not contain any electrically conductive material.
- b) The various materials and additives used to produce extinguishing powders should be non-toxic to humans.
- c) The discharge of large amounts of dry chemical powder may create hazards to personnel in the vicinity such as reduced visibility and temporary breathing difficulty.
- d) Ammonium phosphate and potassium chloride are slightly acidic, and in the presence of moisture, they can corrode metals such as steel, cast iron and aluminium.
- e) Potassium bicarbonate, sodium bicarbonate and urea based potassium bicarbonate are slightly basic and in the presence or moisture they can corrode metal such as aluminium, bronze and titanium.
- f) However, prompt clean up, if done, can avoid such corrosion, ammonium phosphate based

agent will require same scraping and washing if exposed surfaces were hot when the agent was applied.

- g) Dry chemical powder shall not be considered satisfactory for use on machinery such as carding equipment in textile operations and delicate electrical equipment, because upon exposure to temperature in excess of 121°C, or relative humidity in excess of 50 percent deposits will be formed which may be corrosive, conductive of electricity and difficult to remove.

6 SAMPLING AND CRITERIA FOR CONFORMITY

The details of the sampling and criteria for conformity are given in Annex B.

7 PACKING

7.1 The powder shall be packed in hermetically sealed moisture proof plastic bags or containers lined with plastic in the quantities 1, 2, 5, 10, 25 and 50 kg.

7.1.1 The strength of the container used shall be such that no distortion or failure of the container shall occur when it is kept on a flat surface on any of its sides/ends and a weight of 10 kg is applied to it. The container shall not disintegrate to any extent when dropped from a height of 1 m on a concrete surface after being packed.

7.2 The powder of quantity 50 kg shall be packed in HM HDP bag conforming to IS 7406 (Part 2).

8 MARKING

8.1 Each pack containing dry chemical powder shall be labelled with the following information:

- a) Manufacturer's name or trade-mark;
- b) Quantity of the powder, in kg;
- c) Type : Ordinary or foam compatible;
- d) Date of manufacture/Batch No.; and
- e) Percentage of base material.

8.1.1 The packing may also be marked with the Standard Mark.

8.1.1.1 The use of the Standard Mark is governed by the provisions of the *Bureau of Indian Standards Act, 1986* and the Rules and Regulations made thereunder. The details of conditions under which licence for the use of the Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

ANNEX A

(Clause 2)

LIST OF REFERRED INDIAN STANDARDS

IS No.	Title	IS No.	Title
1607 : 1977	Methods for test sieving (<i>first revision</i>)	(Part 2) : 1984	Aqueous film forming foam
4905 : 1968	Methods for random sampling	(Part 3) : 1987	Fluoro protein foam
4989	Foam concentrate (compound) for producing mechanical foam for fire fighting:	7406 (Part 2) : 1986	Jute bags for packing fertilizers: Part 2 Laminated bags manufactured from 380 g/sm ² ; 68 × 39 tarpaulin fabric (<i>first revision</i>)
(Part 1) : 1985	Protein foam (<i>second revision</i>)		

ANNEX B

(Clause 6)

SAMPLING PROCEDURE FOR DRY CHEMICAL POWDER FOR FIGHTING CLASS B AND C FIRES

B-1 SCALE OF SAMPLING

B-1.1 Lot

All the containers in a single consignment of the material of the same type drawn from a single batch of manufacture, shall constitute a lot.

B-1.2 The sample shall be tested from each lot for ascertaining the conformity of the material to the requirements of the standard. The number of containers to be selected from each lot shall depend upon the size of the lot and shall be in accordance with col 1 and 2 of Table 2.

Table 2 Scale of Sampling
(Clause B-1.2)

Sl No.	Lot Size	Sample Size
(1)	(2)	(3)
i)	Up to 50	3
ii)	51 to 100	4
iii)	101 to 150	5
iv)	151 to 300	6
v)	301 and above	7

B-1.2.1 These containers shall be selected from the lot at random. In order to ensure the randomness of selection, procedures given in IS 4905 may be followed.

B-2 NUMBER OF TESTS AND CRITERIA FOR CONFORMITY

B-2.1 Draw with an appropriate sampling instrument

a small portion of the material from different parts of each selected container. Thoroughly mix all portions of the material drawn from the same container. The total quantity of the material drawn from each container shall be sufficient to conduct all the tests given in 4. The material from each of the container so selected, shall be subjected to the tests for apparent density, particle size distribution, water repellency and free flowing. The lot shall be considered as conforming to these requirements if all the samples meet the requirements.

B-2.2 For the tests for hygroscopicity, caking and heat, a composite sample shall be made of taking small but equal quantity of material from each of the selected containers and one test shall be carried out for each requirements. The lot shall be considered as conforming to these requirements if a sample passes in both the requirements.

B-2.3 The fire test and foam compatibility test (applicable only to foam compatibility type) shall also be carried out on the composite sample. Three samples shall be tested for Class B fire. The lot shall be considered as conforming to the requirements of fire test if at least two samples completely extinguish the fire. For foam compatibility, two samples shall be tested. The lot shall be considered as conforming to the requirements of this test if both the samples pass.

ANNEX C

(Foreword)

COMMITTEE COMPOSITION

Fire Fighting Sectional Committee, CED 22

<i>Organization</i>	<i>Representative(s)</i>
Ministry of Home Affairs, New Delhi	SHRI OM PRAKASH (Chairman) SHRI D. K. SHAMI (<i>Alternate</i>)
Airport Authority of India, New Delhi	SHRI L. C. GUPTA SHRI H. S. RAWAT (<i>Alternate</i>)
Andhra Pradesh Fire Services, Hyderabad	SHRI SWARANJIT SEN
Bhabha Atomic Research Centre, Mumbai	CHIEF FIRE OFFICER
Bombay Fire Brigade, Mumbai	CHIEF FIRE OFFICER SHRI G. S. SAWANT (<i>Alternate</i>)
Central Building Research Institute, Roorkee	DR T. P. SHARMA DR A. K. GUPTA (<i>Alternate</i>)
Central Industrial Security Force, New Delhi	DEPUTY INSPECTOR GENERAL (FIRE) SHRI S. L. NAGARKAR (<i>Alternate</i>)
Central Public Works Department, New Delhi	CHIEF ENGINEER (E)
Centre for Environment and Explosive Safety, Delhi	SHRI A. K. KAPOOR SHRI H. S. KAPARWAN (<i>Alternate</i>)
Concord Arai Pvt Limited, Chennai	SHRI R. RAMAKRISHNAN
Controllorate of Quality Assurance (Fire), Pune	COI G. P. KRISHNAMURTHY
Defence Research and Development Organization, Delhi	DIRECTOR (FIRE SAFETY) DEPUTY DIRECTOR (FIRE SAFETY) (<i>Alternate</i>)
Delhi Fire Service, New Delhi	SHRI R. C. SHARMA SHRI SURINDER KUMAR (<i>Alternate</i>)
Directorate General of Supplies and Disposals, Hyderabad	SHRI M. GANGARAJU SHRI V. K. VERMA (<i>Alternate</i>)
Engineer-in-Chief's Branch, New Delhi	SHRI R. A. DUBEY SHRI AJAY SHANKAR (<i>Alternate</i>)
Fire and Safety Appliances Company, Kolkata	SHRI S. N. KUNDU
Home Department (Fire Service), Chennai	DIRECTOR DEPUTY DIRECTOR (<i>Alternate</i>)
Institution of Fire Engineers (India), New Delhi	PRESIDENT GENERAL SECRETARY (<i>Alternate</i>)
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K.V. Fire Chemicals, Navi Mumbai	SHRI H. M. SARADRA
Loss Prevention Association of India, Mumbai	MANAGING DIRECTOR SHRI D. K. SARKAR (<i>Alternate</i>)
Mather and Platt (India) Limited, New Delhi	SHRI DEEPAK AGARWAL
MECON Limited, Ranchi	SHRI R. N. CHACHRA SHRI SUNIL DAS (<i>Alternate</i>)
Newage Industries, Mumbai	SHRI B. J. SHAH SHRI A. M. SHAH (<i>Alternate</i>)
Northern Railway, New Delhi	SHRI I. M. MANSOORI
Oil and Natural Gas Commission, Dehra Dun	SHRI R. P. SAXENA SHRI NEERAJ SHARMA (<i>Alternate</i>)
Oil Industry Safety Directorate, New Delhi	JOINT DIRECTOR (PROCESS)
Real Value Appliances Limited, New Delhi	SHRI ASHUTOSH MANGAL
Safex Fire Services Limited, Mumbai	SHRI JITENDRA SHAH SHRI SANDIP SHAH (<i>Alternate</i>)

(Continued on page 13)

(Continued from page 12)

<i>Organization</i>	<i>Representative(s)</i>
State Bank of India, Mumbai	SHRI I. S. GAHLAUT
State Fire Training Centre, Mumbai	DR NAVINCHANDRA JAIN
Steel Authority of India, Bokaro	SHRI A. RAUTELA SHRI C. P. SINGH (<i>Alternate</i>)
Steel Authority of India, Rourkela	SHRI B. N. DAS SHRI B. P. DAS (<i>Alternate</i>)
Steelage Industries Limited, New Delhi	CHIEF EXECUTIVE: SHRI V. KAMALANATHA (<i>Alternate</i>)
Surex Production and Sales (P) Limited, Kolkata	SHRI TARIT SUR SHRI D. NEOGI (<i>Alternate</i>)
Tariff Advisory Committee, Mumbai	SHRI A. MUKHERJEE SHRI H. C. MAHESH KUMAR (<i>Alternate</i>)
Tariff Advisory Committee, Chennai	SHRI T. R. A. KRISHNAN
Vijay Fire Protection Systems Pvt Limited, Mumbai	SHRI HARISH SALOT
West Bengal Fire Service, Kolkata	SHRI B. PATHAK
In personal capacity (33/2965-A, Vennala High School Road, Vennala, Cochin)	SHRI G. B. MENON
In personal capacity (29/25, Rajendra Nagar, New Delhi)	SHRI S. K. DHIRI
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